

## TOUCH SURFACE FOR SIMULATING MATERIALS

### TECHNICAL FIELD

[0001] This disclosure relates generally to touch surfaces, and more specifically to a touch surface for simulating materials.

### BACKGROUND

[0002] Electronic devices may have touch devices that include touch surfaces for receiving input from, and/or providing output to, one or more users. Such touch devices may include touch screens, track pads, button elements, and/or other such touch devices. In some cases, the touch devices may be able to detect a touch (such as the touch of a user's body part, a stylus, and/or other such touch) and interpret that touch as input. Such touch detection may include detection that a touch has occurred, the location of the touch, the force of the touch, the duration of the touch, movement across the touch surface associated with the touch, and/or any other such characteristics of the touch. In various cases, the touch device may be able to provide output, such as haptic feedback and/or output.

[0003] Typically, touch surfaces are smooth surfaces constructed of various plastics, metals, or glass. The tactile characteristics of such touch surfaces may be limited by the physical characteristics of the materials utilized to construct the surfaces.

### SUMMARY

[0004] The present disclosure discloses systems and methods for simulating materials using touch surfaces. In one or more embodiments, a system for simulating materials using touch surfaces may include at least one touch surface, at least one actuator or at least one temperature control device, and at least one control unit. The control unit may control the actuator or the temperature control device to cause at least a portion of the touch surface to simulate a material.

[0005] Such control may include utilizing the actuator to vibrate at least a portion of the touch surface. Such vibrations may simulate the tactile sensation of texture. In some cases, the vibrations may be varied over time, such as in response to one or more touches detected using one or more touch sensors.

[0006] Such control may also include utilizing the temperature control device (such as a Peltier device) to control the temperature of at least a portion of the touch surface in order to simulate the tactile sensation of the thermal conductivity of a material. In some cases, the temperature control may be performed utilizing data from one or more temperature sensors to adjust the temperature of the touch surface. In some cases, the temperature may be varied over time, such as in response to one or more touches detected using one or more touch sensors.

[0007] In various implementations, the entire touch surface may be caused to simulate the material. However, in other implementations, the touch surface may include a plurality of regions that are each controllable. In some cases, each of the plurality of regions may include one or more actuators, temperature control devices, touch sensors, and/or temperature sensors. Further, in various cases, each of the plurality of regions may be simultaneously controllable to simulate different materials than one or more of the other regions.

[0008] In some implementations, the touch surface may include a layer of diamond material. The diamond material may be a layer of chemical vapor deposited diamond, such as a layer of carbon vapor deposited diamond. Such a layer of diamond may provide extremely high thermal conductivity, extreme mechanical hardness, and/or optical broadband optical transparency.

[0009] In some embodiments, a method for simulating materials using a touch surface may include determining at least one material to simulate using a touch surface and controlling at least one of at least one actuator or at least one temperature control device to cause the at least one touch surface to simulate at least one material.

[0010] In various embodiments, a touch device may include at least one touch surface, at least one actuator or at least one temperature control device, and at least one control unit. The control unit may control the actuator or the temperature control device to cause at least a portion of the touch surface to simulate a material.

[0011] It is to be understood that both the foregoing general description and the following detailed description are for purposes of example and explanation and do not necessarily limit the present disclosure. The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate subject matter of the disclosure. Together, the descriptions and the drawings serve to explain the principles of the disclosure.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1A is an isometric view of an example system for simulating materials using touch surfaces.

[0013] FIG. 1B is a front cross-sectional view of the example system of FIG. 1 taken along line 1B in FIG. 1.

[0014] FIG. 1C is a block diagram illustrating an example functional relationship of the components of the touch device system of the example system of FIG. 1B.

[0015] FIG. 2 is a bottom view of an alternative embodiment of a portion of the example system of FIG. 1A.

[0016] FIG. 3 is a flow chart illustrating a method for simulating materials using touch surfaces. This method may be performed by the system of FIG. 1A-1C or 2.

### DETAILED DESCRIPTION

[0017] The description that follows includes sample systems, methods, and computer program products that embody various elements of the present disclosure. However, it should be understood that the described disclosure may be practiced in a variety of forms in addition to those described herein.

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[0019] The present disclosure discloses systems and methods for simulating materials using touch surfaces. A touch device may include at least one touch surface, at least one actuator or at least one temperature control device, and at least one control unit. The control unit may control the actuator or the temperature control device to cause at least a portion of the touch surface to simulate a material.

[0020] Such control may include utilizing the actuator to move vertically and/or horizontally to vibrate at least a portion of the touch surface. Such vibrations may simulate the